Silent Inspector Primer

A Guide for the Implementation Of The Silent Inspector

Version 1.0

Silent Inspector Primer:
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Introduction

The purpose of this Primer is to provide the reader with a general understanding of the automated dredging quality assurance monitoring system known as the Silent Inspector (SI). The content of the SI Primer was developed based on Frequently Asked Questions received by the SI Team. Information is organized by topic, with general questions and information provided in the main document and more detailed information provided in Appendix A. The SI User Manual compliments this Primer and is available at the SI website: http://si.usace.army.mil. For a more comprehensive review of the SI system and user tools, training on the SI is available through the SI team.

The Director of Civil Works (DCW) implemented SI nationally through his memorandum dated 17 April 2006 to aid Districts in dredging inspection and monitoring. SI should be used to reduce overall monitoring costs. By requiring SI on all U.S. Army Corps of Engineers (Corps) hopper and scow dredging, and expanding to pipeline and mechanical dredges in the near future, the Corps' capabilities in dredging inspections will be improved. Utilizing SI on a 24 hours/7days a week basis will also create a very valuable engineering and performance database we can use to improve our business practices, ensure environmental compliance, and increase our understanding of dredging science and technology. The policies for operation and use of SI will be defined by amendments to the existing dredging Engineer Regulations and Pamphlets.

A technical support center was stood up at the Mobile District under the Chief, Operations Division, Mr. W. Wynne Fuller. The mission of the SI team is to provide Corps-wide technical support including dredge certifications, data quality control, database management, support for the SI desktop software, and to continue to evolve capabilities to support Corps dredging needs. Operational support includes tools and services to assimilate, analyze, and report dredging quality assurance data. The SI implementation is structured so that the Major Subordinate Commands (MSCs) and Districts require no additional personnel to full implement SI use. An SI Board of Directors comprised of representatives from Headquarters, Divisions, and Districts, provide management oversight to the SI program. Support for all SI functions and applications are available from the national SI support team:

Mr. Gary Howell	251-441-5731 (office)	601-831-0769 (mobile)
Ms. Rhonda Lenoir	251-690-3011 (office)	601-618-0755 (mobile)
Mr. Jay Rosati	251-441-5535 (office)	601-831-7227 (mobile)
Mr. Tim Welp	601-634-2083 (office)	601-415-3438 (mobile)
Ms. Linda Lillycrop	251-690-2593 (office)	251-327-6602 (mobile)
Mr. Eddie Culpepper	251-690-3467 (office)	251-591-5117 (mobile)

The SI Team can also be contacted through email at: chl-sics@erdc.usace.army.mil, and additional information regarding the SI is available on the SI website: http://si.usace.army.mil.

Currently, funding to support SI comes from each dredging contract by sending via MIPR an amount equal to 0.875 percent of the hopper or scow contract total, to Mobile District, P2 resource code is OTHFACSVCS and the Org Code is K5R0N00. The financial POC is Evelyn D. Davis, 251-690-2311 and the program POC is Mr. Eddie Culpepper, 251-690-3467.

Background

What is the Silent Inspector?

The hopper and pipeline dredge SI systems integrate various automated systems to record digital dredging and disposal activities for both government-owned and contract dredges in real-time on a 24 hour/7days a week basis. Both SI systems collect and record measurements from shipboard sensors, calculate the dredging activities, and display this information using standard reports and graphical displays. This information is recorded to the on-board computer where it is available to the Corps Quality Assurance Representatives (QAR) for examination and for periodic download and transmittal via an automated email service for inclusion in the SI database. The SI implements a management process (specifications and standards) in cooperation with dredging contracts, and is a Corps-wide requirement for all contract and permit dredging utilizing hopper dredges and scows. SI monitoring for pipeline dredges is currently in the demonstration phase.

Why was the SI system developed?

Since the reduction of the government-owned hydraulic dredge fleet in 1976, the role of the Corps shifted from dredge owner/operator to contract inspector and administrator. With reduced Federal inspector manpower and increased dredging contracts, the Corps' ability to perform adequate contractor oversight was significantly impaired (Rosati and Welp 1999). Therefore, automated systems were developed to assist dredging inspectors in project management and to provide more accurate monitoring of dredge activities utilizing hopper and pipeline dredges and scows. The Dredging Operations Environmental Research (DOER) Program SI work unit was established in 1998 to develop standardized, automated monitoring SI systems for Corps-wide hopper and pipeline dredging activities. The objectives of the SI systems are to assist dredge inspectors, dredging project and contract managers in monitoring dredging position and dredge production status, and to provide trustworthy facts for dispute resolution.

When and Why should I use SI?

The current SI Corps-wide implementation requires the use of SI for all hopper dredges and dump scows. For hopper dredges the Corps has three authorities that cover the dredges operation: contract dredging, permit dredging, and reserve fleet designation. All hopper and scow dredging contracts and permits shall require SI certification and operation. SI monitoring for pipeline dredges is currently in the demonstration phase.

SI System

What are the SI system components?

The SI Hopper and Pipeline systems have three major computer components: the Dredge Specific System (DSS), the Ship Server, and the Shore System. The DSS is comprised of the dredges computer-based systems for positioning and control of the dredge. The DSS collects various dredge sensor data, and formats and displays these data to the dredge crew to provide quality control of the dredging project. The Ship Server is another computer on the dredge loaded with Corps SI software. The DSS sends data in near real-time to the Ship Server, which performs tasks that include automated review of data for quality assurance, data archival, report generation, and graphical displays of data. The Shore System is a shore-based computer which provides the same functionality as the Ship Server, but has greater data storage and reporting capabilities. Data are transferred from dredges by wireless data link or physically transported with magnetic media (i.e. jump drive) and are archived on the Shore System.

What hardware is needed to implement SI?
The contractor/permittee owns, installs, and operates all instrumentation and computers; therefore the contractor/permittee decides which kind of hardware is utilized on the dredge. However, it is a requirement that the hardware used meets the performance- based specifications for SI. Most hopper and large pipeline dredges are equipped with the necessary hardware and sensors.

Who purchases and owns equipment?
The DSS and all shipboard sensors are purchased by the contractor and remain the property of the contractor. The contractor is required to maintain the sensors. The contractor purchases the Ship Server computer hardware for the Corps, and the Corps installs the SI software. The Shore System consists of Corps-supplied hardware and software.

What data does SI collect/measure?
Both hopper and pipeline dredge SI systems monitor dredge position and dredge state, and report and manage these data for Corps dredging contracts. However, each system collects data and computes measurements specific to each dredging type. The hopper dredge SI system computes Tons Dry Solids (TDS). The data collected by each SI system is summarized in Table 1, and depicted in Figure 1a and 1b.

Table 1. Data Collected for Hopper and Pipeline Dredge SI Systems

Hopper Dredge	**Pipeline Dredge**
Horizontal position	Cutterhead horizontal position and depth
Ship speed and heading	Slurry velocity and density
Draft, displacement	Tide level or river stage
Tide level	Dredge heading
Hopper status (open/closed)	N/A
Hopper ullage and volume	N/A
Draghead depth	N/A
Material recovery and min. pump effort	N/A

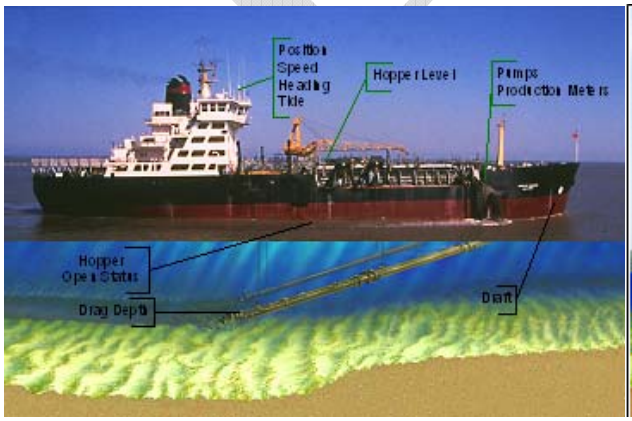

Figure 1a. SI Hopper Dredge Measurements

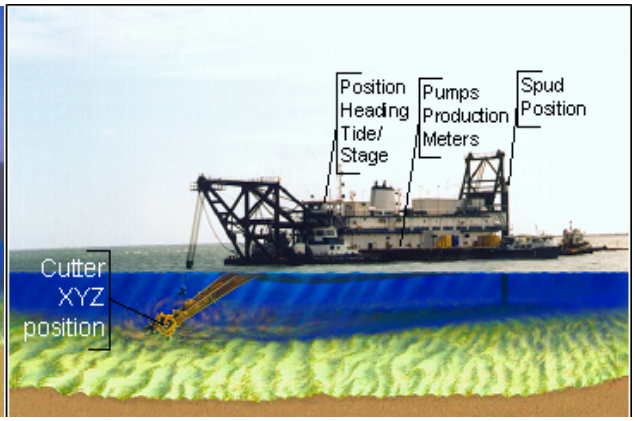

Figure 1b. SI Pipeline Dredge Measurements

How does SI monitor Scows?
The scow monitoring specification has three profiles: tracking, monitoring, and TDS in order of increasing level of instrumentation requirements and cost. The mandated minimum level is the tracking profile which can be implemented at low cost based on adapting truck trailer monitoring equipment. The low non-recurring cost of instrumentation makes the permanent installation more advantageous for contractors than paying the cost for technicians to install and uninstall on a per contract basis.

What does “Always-On” mean?
The SI Implementation is a nationwide “always-on” operation. “Always-on” means that all contractor and government dredges will be monitored through the SI for all dredging projects, and the SI system is always operational; even between projects. These include regulatory jobs performed for non-Corps clients. A cost analysis of SI implementations has shown additional costs are incurred due to frequent reinstallation and startups. By installing and certifying instrumentation and software and keeping it "always-on", the Corps will achieve full coverage of dredging operations, reduced monitoring costs for the Corps and dredge operators, and the SI team awareness of 24/7 system functionality.

Can a contractor disable a sensor or the SI when he doesn’t want to be monitored?
With the Corps-wide SI implementation, the SI guide specification has the requirement that the SI be utilized and “always-on”. The contractor can turn a sensor or the SI off, but he does so at his own risk. The SI analyzes and checks data in real-time to identify potential problems and notifies the inspector when a problem condition is present.

Who is responsible for keeping the SI working?
The SI team is responsible for supporting the software (program) and the contractor is responsible for supporting the hardware (sensors). The SI’s serial interface has been designed to aid in the identification of the source of problems

SI Implementation

What is the SI Implementation process?
The SI System implementation process is one of continuous improvement and is described in the following major steps:

- *Step 1*. Corps development of SI contract specifications and submittal of those Specifications to the contractor (via the contracting process)
- *Step 2*. Contractor development of a Dredge Plant Instrumentation Plan (DPIP), and submittal of the DPIP to the Corps SI team
- *Step 3*. Corps SI team approval of the DPIP
- *Step 4*. Contractor provides an operational SI system
- *Step 5*. Corps SI team installs SI software
- *Step 6*. Corps SI team inspects SI system (Certification)
- *Step 7*. Continued quality assurance testing and contractor quality control throughout dredging operations (Corps and contractor)
- *Step 8*. Incorporate lessons learned and technology improvements into the contract specifications and repeat *Steps 1-7* for subsequent projects

What type of contracts should SI be used on?

The SI should be used on all hopper and scow contracts. The SI is most directly useful for rental contracts; since the government must be assured that the contractor is operating the dredge in the most efficient manner. The SI provides sufficient data to defend the government against claims and reduces the likelihood of claims. Some Districts impose various operating restrictions on dredge operations for environmental reasons; the SI can monitor the dredge to assure these conditions are met. An example is to monitor compliance for open water and ocean disposals.

How do I add SI to the Contract Specifications?

The SI contract specifications define and describe the Corps and dredging contractor relationship with regard to SI system equipment, data collection, data quality control, and data quality assurance. Detailed information regarding the SI contract specification guide can be obtained from the SI website: http://si.usace.army.mil or by contacting the SI Team.

Because dredging contract requirements vary between Corps Districts, each District can tailor the SI contract specifications to meet specific dredging needs. These specifications may differ from contract to contract if different types of dredging are required. However, a goal of the SI program is to standardize monitoring requirements so that a contractor's dredge may work for various Corps Districts with minimum modifications to meet disparate monitoring requirements. The SI specifications are included in dredging contract bid packages distributed by the District.

What should be included in the contract language for SI?

Tailoring the standard SI specs could include:

- The scow specifications should specify the monitoring or TDS profile for if an ODMDS site will be used.
- Create or modify the example penalty clauses for compliance for a working system.
- If the District wishes for the contractor to perform the manual data transfers, then the contract should state this. Example language will be provided on the SI website.

Transferring Data - Scow data are transferred by the contractor automatically to the SI database. Load summary data are transferred via the contractor provided satellite phone. Detailed data are transferred via USB jump drive. This transfer can be performed either by the QAR or the contractor. A QAR would typically use the SI send data program included in the SI Manager Station software installation to send the data. This process is documented in the QAR bridge section of the SI website. Contractors can use a standalone version of the SI send data program (downloaded from the SI website QAR bridge section) to send the detailed data to the SI database.

What is the Dredge Plant Instrumentation Plan (DPIP)?
The SI specifications require the contractor to submit a DPIP (Step 2). The DPIP documents the contractor's SI monitoring equipment and operations, and supplies extensive information about the dredge that is needed by the Corps to fulfill its data quality assurance role. Detailed information regarding the DPIP is provided in Appendix A.

What is required for SI dredge certification?
Acceptance of the DPIP and successful dredge inspection are required for SI dredge certification. Detailed information regarding the SI Dredge Certification is provided in Appendix A. A Certificate of SI Inspection will be issued with the SI Inspection Report

Who conducts the dredge certifications?
Under the national SI implementation, all dredge certifications will be managed and performed at the national level by the SI team. Dredge certifications are required annually, as a minimum. A list of certified hopper dredges and scows is available at http://si.usace.army.mil . As of October 2006, the following hopper dredges are current with SI certification:

Atchafalaya	Manhattan Island	Bayport	Newport
B.E. Lindholm	Padre Island	Columbia	R.N. Weeks
Dodge Island	Stuyvesant	Eagle 1	Sugar Island
Glenn Edwards	Westport		

How often does a dredge have to be re-certified?
Duration of the inspection certification is one year from issue date of the inspection report. The dredge must be re-inspected earlier if:

- Significant changes are completed in major ship overhauls.
- Any major overhauls or changes are made to the sensor or computer system.
- Each project sponsor has the option, as per the contract specifications, to conduct additional checks and tests they deem necessary to ensure quality data.

Are there any other checks to be conducted by the Contractor?
A draghead depth check shall be conducted and documented by the contractor on a monthly basis. This documentation shall be entered in the sensor maintenance log stored onboard the dredge.

SI Data Management

Where is the data stored? Is the data secured?
The *SI* database is an enterprise system that holds all dredge data nationwide. The database is located on a secure server, which can only be accessed by Corps authorized users, and automatically stores data acquired from the on-dredge *SI* systems. The SI Support team is responsible for managing and maintaining the SI database and server.

Can I load historical data and past contract data into the SI database?
Years of older dredge data remains in various formats spread around districts and project offices. Historical data can be loaded; however it is presently costly. A consensus of standards and development of common tools will reduce the effort to populate historical data. The SI software

does enables users to enter detailed contract information into the SI database. Contact the SI Team concerning the importation of dredge monitoring data not collected by the SI.

How do I view the SI data/measurements?
The SI Data Explorer and SI Plots are desktop programs developed for viewing and plotting all data from all dredges in the SI database. The District POCs use the SI desktop programs to monitor dredging operations and review SI data. The SI software is provided to Districts at no cost and installation can be conducted through District Information Management staff. Installation support is available from the SI support team. The detailed time series SI data are considered proprietary by dredging contractors. Only the Corps has access to the SI Data Explorer program. The permittee or consultant must make arrangements for access to process data directly with the contractor. Summary data (i.e., automated email load reports) can be made available from the SI to the permittee at the discretion of the District Regulatory POC. The SI Data Explorer and SI Plots Users Manual is provided in Appendix B.

SI Training

How do I get SI training?
Training courses on SI implementation and use of the SI software will be coordinated by the MSC SI POCs. Training will be organized on a regional basis and held at an MSC selected District. The MSC POCs shall coordinate with Districts and the SI team to coordinate training dates and select venues. SI Training is scheduled to initiate in September 2006. Information on the training schedule and locations will be available on the SI web site http://si.wes.army.mil/.

Who pays for training?
The SI support team is responsible for funding the instructor, training documents, and software. There are no registration fees for training; each District is responsible for costs incurred for student travel and labor. Since training will be held at Corps facilities, costs for training venues should not be incurred.

Roles: District, Division, National Team

Each MSC and District should appoint main and alternate SI Point of Contacts (POCs) for Operations or Construction and Regulatory. The MSC POCs should have oversight responsibilities for navigation and environmental compliance of the MSC and District dredging mission. The POC's responsibilities are to coordinate regional standardization efforts among the Districts, coordinate training requirements across the Districts, and act as the POC for SI training courses. The SI team will support the MSC in negotiations with the EPA and other regulatory agencies in regional standardization of reporting requirements. The District POC's responsibilities are to ensure District review of SI data, interface with the SI support team, identify District needs and issues, coordinate training and technical support with the MSC SI POCs, and provide the SI support team District POCs for transfer of information.

SI and Environmental Monitoring

How does the SI assist in monitoring for environmental compliance?
Districts are continually constrained by environmental resource agencies which restrict the dredging and disposal locations and depths. The Portland District requested that *SI* be enhanced

to provide real-time alarms and archival logging of drag-head position outside of pre-configured boundaries and depths. Threatened and Endangered (T&E) experts have requested similar monitoring of operations in turtle and other T&E sensitive channels. Also the incident reports which human turtle monitors provide can benefit from the existing *SI* infrastructure on hopper dredges to transmit and store their incident reports. The objective is to provide quantitative support for negotiations with resource agencies and potentially avoid unnecessary operational constraints.

Turtle Monitoring

Currently, available measurements useful for turtle safe operation monitoring include: draghead depth, draghead flow velocity, and slurry density. A training video is under development to assist interpretation of dredging activities for turtle monitoring.

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Appendix A:
Additional Information

Appendix A: Additional Information

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SI Implementation

What do the SI contract specifications include?

In general, the SI contract specifications for hopper and pipeline dredges include details related to the following topics:

- DPIP requirements
- Contractor-provided sensor and data requirements
  - Type, number, and locations
  - Quality control criteria
  - Minimum data performance requirements
  - Data reporting and format
  - Reference datum(s)
- Contractor-provided computer equipment
- Data-reporting interface requirements
- Quality assurance test descriptions and requirements (predredging and during dredging)
- Table of contractor-specific deliverables
- DPIP submittal schedule
- Data format examples and related definitions

What information is provided in the DPIP?

The DPIP provides details to the Corps about the dredge and equipment, data collection and procedures, and quality control (QC) measures. The DPIP must show how the contractor will conduct the following tasks:

- Gather sensor data
- Compute required data elements
- Perform quality control on those data
- Calibrate and repair sensors/data reporting equipment when they fail
- Distribute the sensor data and computed dredge-specific data to the Corps via a standard interface

Information about dredge dimensions and sensor layouts are needed in the DPIP so the Corps can adequately perform a dredge inspection. The SI specifications require that a certified marine surveyor or architect certify most dredge dimensions. Descriptive information about the dredge and SI system equipment (sensors and computers) must be included in the DPIP. Table A-1 lists the different information types required in the DPIP for hopper and pipeline dredges.

What is the process for DPIP approval?

Once the contractor submits the DPIP, the Corps reviews the DPIP within a specified time period (denoted in SI contract specifications). The DPIP is emailed in PDF format. One hardcopy is printed to be used as a working document. Upon written DPIP acceptance, the working copy is destroyed (shredded) and the PDF file deleted; the contractor then sends one final hardcopy to reside on file at the ERDC. Once written, the contractor should update the DPIP and submit for approval when sensor upgrades or dredge plant modifications occur. The approved DPIP can be transferred between Districts at their discretion. Once the Corps approves the DPIP, the dredging contractors should have their DSS reporting the required data to the Ship Server within the time period stipulated in the SI specifications.

Table A-1. Required DPIP Information for Hopper and Pipeline Dredges		
Information Types	Hopper Dredge	Pipeline Dredge
Dredge computation procedures	Vessel displacement	Cutterhead position
	Hopper material volume	
	Ullage table	
	Material recovery	Cutterhead depth
	Pumping water	Dredge production
	Minimum pumping effort	
Dredge dimensions	Dragpipe lengths and inside pipe diameter	Cutterhead and inside pipe diameter
	Offset distance from DGPS antenna to center line of each draghead	Offset distance from DGPS antenna to the center line of the cutterhead
	Distances from fore and aft draft sensors: • Horizontal and vertical distances from the keel and between each draft sensor • Vertical distances to the hopper level sensors • Distances from aft draft sensor to aft perpendicular and midship section • Distances of fore draft sensor to fore perpendicular and midship section	Slurry density and slurry velocity sensor locations
	Draft and hopper sensor offsets	
Dimensioned drawings	Overall dredge	Overall dredge, including hull and decks, sensor locations, cutter basket diameter, distance between spuds, and suction ladder length(s)
	Hopper, including hopper length, depth, and width, with hopper level sensors referenced to overall dimensions	
	Typical mid-ship cross section	
Quality control methods	Sensor calibration checks	Sensor calibration checks
	Data quality checks	Data quality checks
	Quality assurance tests and checks	Quality assurance tests and checks
Contractor-provided computer hardware and software	Brand name	Brand name
	Specifications	Specifications
Data reporting interface	Proposed revisions	Proposed revisions
Sensors1	Brand name	Brand name
	Description of sensor operation and accuracy according to manufacturer specifications	Description of sensor operation and accuracy according to manufacturer specifications
	Certificates of calibration and/or manufacturer certificates of compliance for draft, slurry density and velocity, hopper level, water depth, and draghead depth sensors	Certificates of calibration and/or manufacturer certificates of compliance for slurry density and velocity, and cutterhead depth sensors
1 Note: Sensor manuals do not constitute a submittal of sensor descriptions and calibration information.		

Who notifies whom regarding coordination for performing the certification inspection and modifications to the DPIP?

SI Team personnel will contact the dredging contractor to coordinate the annual inspection within 2 months prior to the dredge's annual certification expiration date. The Contractor is required to contact SI Team personnel to inform them of scheduled major ship overhauls and any major overhauls or changes made to the sensor or computer system. The Contractor will provide DPIP revisions to reflect any of these significant changes immediately after the action has been completed.

What does an SI Certification Inspection consist of?

An onsite dredge inspection is conducted to assure that the contractor's instrumentation system (sensors, data acquisition equipment, and software) meets the contract specified performance requirements. With the successful completion of the dredge inspection, the quality of the provided dredge data can be assured. Subsequently quality assurance checks during the duration of the contract will provide the basis for continued confidence in the dredge data.

Data quality checks include:

a. Displacement (Draft) Check
b. Ullage (Hopper Level) Check
c. Draghead Depth Check
d. Watertest
e. Relative Water Level Check (Bottom Door Hoppers Only)

What's a Displacement (Draft) Check?

The purpose of the displacement (draft) check is to verify accuracy of displacement gages forward and aft. If required, the inspector boards an auxiliary vessel and circles the dredge to observe and record draft markings forward and aft (both port and starboard). The dredge's bridge is hailed and asked to relay the SI-reported fore and aft draft values. The (averaged) manual measured drafts are then compared to system-measured values. During the check, the dredge should lie in relatively calm waters to minimize wave induced measurement error. In quiescent wave conditions and with well-calibrated equipment, this check takes approximately 10 minutes to complete. As wave heights increase, measurement error increases accordingly.

What's an Ullage (Hopper Level) Check?

The ullage check's purpose is to verify that the system draghead depth measurements are within the required accuracy of + 0.5 ft of the manual measurements. The hopper is filled to two different levels with enough material to provide single, continuous, horizontal fluid planes for each measurement (1/3 and full hopper). The inspector proceeds to the appropriate sounding stations to measure the ullage (distance from top of hopper to top of hopper material). The manual soundings are then compared to the system-measured values (the minimum required accuracy is equal to or less than +0.1 ft of the manual measurement), but as wave heights increase, measurement error can increase accordingly. In relatively quiescent wave conditions and with well-calibrated equipment, this check takes approximately 20-30 minutes to complete the manual measurements, but additional time can be required to fill the hopper depending on dredge-specific equipment and loading conditions.

What's a Draghead Depth Check?

The purpose of the draghead depth check is to verify that the system draghead depth measurements are within the required accuracy of + 0.5 ft of the respective manual measurements. Draghead depth data is relative to the water surface level without tidal elevation adjustments (draghead elevation is defined as draghead depth with tide elevation adjustments applied). A clearly readable steel tape, chain, or wire is fastened to the draghead and it is lowered into the water. The dragtender positions the draghead to various predetermined depths and the tape is measured relative to water surface at these positions. System and manual depth values are compared throughout this process to ensure accuracy requirements. In relatively quiescent wave conditions and with well-calibrated equipment, this check takes approximately 30 minutes to complete.

What's a Water Test?

A water test consists of pumping the hopper out to its lowest level (to measure empty ship's weight) and then filling the hopper to capacity with water (to measure loaded ship's weight). The water test is not a performance test to determine pumping capacity as a function of water pumped in a given time interval. Empty ship's weight is subtracted from loaded ship's weight to determine weight of water in the hopper, and water volume is determined from the ullage table. A water sample is then retrieved from the hopper and measured with a refractometer. The objective of the water test is to assure data consistency by comparing the system-measured water specific gravity to that of the manually measured sample. The relative difference between these two values should be less than 5%. In relatively quiescent wave conditions and with well-calibrated equipment, this check generally takes approximately 45 - 60 minutes to complete.

What's a Relative Water Level Check?

The fixed distance between the draft and ullage sensors allows a quality assurance test to be conducted on hopper dredges with bottom dump doors. The relative water level test consists of opening the bottom dump doors (or corresponding equipment) to allow the water level surrounding the dredge to equalize with the water level in the hopper and comparing the draft and ullage sensor-measured values of the same water plane. With minimal wave action, the measured difference should be within +0.5 ft.

How will SI save me money?

Reduction in Paperwork

The original *SI* database design was oriented around the recording of data from the dredge and providing reports to the QARs. As districts deal with increasing personnel shortages, they would like to eliminate steps in the flow of paperwork required for the existing contract monitoring business process. Using principles of PMBP the *SI* data explorer and database can evolve into a work flow automation system that will both save time and capture more business data.

Bin Measure Payment

One of the features of the hopper dredge *SI* is the measurement of the dry weight of the material in the hopper. This technology known as Tonnes Dry Solids (TDS) (Welp and Rosati 2000) was developed in The Netherlands and is the basis for their bin measure payment contracts. The *SI* TDS system was independently developed on the same principles. The Corps controls the

algorithms and software used to compute TDS. Significant savings in QA costs could be realized for certain types of contracts if automated bin measurement was accepted by all stakeholders.

The present R&D involves analyzing and documenting the accuracy of the TDS measurements, and refining the algorithms based on experience on real-world district contracts. Support is also provided to districts interested in automated bin measurement to test how various measurement and contracting strategies would perform vs. the existing methods. Previously measured data can be analyzed to determine the contract costs if a given algorithm and payment strategy had been used.

Always-on

If a district could assume that all hopper dredges and scows always had an operational SI system they could realize more of the potential benefits. Direct benefits would include the use of the system for short rental contracts. Dredge swapping by contractors during the course of a contract would have no effect on monitoring plans. Dredge substitution as occurred during emergency response to the 04 hurricane season would also cause no impact on QA.

Short contracts would benefit from reduced inspection costs if SI was always available. Rentals contracts are frequently short contracts. Though many small dredging districts use pay-by-survey, the other benefits of digital data storage, enterprise tools, T&E species monitoring, and dredge management optimization would accrue.

RSM and DMMP data

New management requirements such as Regional Sediment Management (RSM) and Dredge Material Management Plans (DMMP) have developed dredge data requirements beyond the traditional contract QA and payment requirements. For the Corps to manage its sediment resources objectively, digital data on the source and disposition of sediments during dredging is imperative. These requirements could be met by always-on *SI* operation on hopper dredges and mandatory minimum monitoring of dump scows.

Threatened and endangered species response

Part of the Corps response to T&E species protection could be met by use of simple additions to *SI* capability. First, turtle monitor reports would benefit from the existing database and real-time communications infrastructure provided by the *SI* computer on board hopper dredges. By storing the reports as additional fields in the *SI* database, environmental experts would have access to all other spatial, temporal, and operational context associated with T&E incidents. This context data is invaluable in helping the expert recommend an operational response.

Second, the Corps and contractors could work together to develop turtle safe operating procedures. *SI* monitoring of these procedures could be used for both a real-time and post-load management. Monitoring provides resource agencies confidence that procedures will be followed. The existing *SI* alarms system can provide alarms for *drag head off the bottom with pumps on* condition. This would operate in a similar fashion as the drag head depth alarms used by Portland district.

Example Deployments

The first operational deployments of *SI* occurred in 1999 for the SAM Mobile harbor project. This project is a long term rental contract for channel maintenance. The project is characterized by fine sediments which must be dredged without overflow. The project has routinely used *SI* since 1999 and has justified deployment costs on direct savings of QAR (inspector) costs. Mobile district has also funded significant enhancements to the system. These include the metadata for rental contract management, data entry and editing screens, real-time data reporting, and integration with the e-Coastal GIS.

Originally Mobile district required SI for long rental contracts in Mobile harbor. As the availability of certified dredges has increased, they now require SI for all hopper contracts.

New Orleans District

New Orleans district's first SI hopper dredging contract was in 2001. In addition to the traditional uses of SI the district has supported efforts to use the system for pay-for-performance contracts in place of existing rentals. They have also worked with R&D staff to develop a real-time economic load analysis and display capability (Howell and Clark 2002). In FY04 the district began placing SI requirements in their contract specifications for all hopper dredging contracts.

Portland District

Portland district has an on-going *SI* implementation that began as an experimental deployment supported by the DOER program. *SI* was evaluated to determine how well it would function in the unique environment of the Mouth of the Columbia River (MCR). This project uses contract hopper dredges with bin measure payment. Traditionally the bin measures have been performed manually by government QARs. Since FY03 the district has engaged in a graduated test and deploy strategy aimed initially at automation of Form 27 reporting. In FY03 the *SI* began operation aboard the government dredge *Essayons*. The government hopper dredge *Yaquina* does not have the instrumentation suite required to support *SI*.

The district has pioneered the use of *SI* to perform real-time monitoring of drag-head depth and position. It has also commissioned real-time dump-position reports to monitor and fine-tune disposal area templates. An ultimate goal is the reduction or elimination of full-time QARs board the contract dredges. This would require a bin measurement system that is accepted as sufficiently accurate for payment. Acceptance implies technical documentation and buy-in from the district and industry. This remains an unsatisfied R&D requirement. The district requires *SI* for all hopper and scow contracts. Implementation of the *SI* on the *Yaquina* is not scheduled pending funding. Portland District is presently pursuing implementation of the *eGIS* system and integration with the *SI* database could occur in the future.

Jacksonville District

Jacksonville district requires S*I* for all hopper dredge contracts including regulatory contracts. The first contract monitored was in FY04. Recent emergency dredging at Port Canaveral used *SI* to document turtle takes and allow management of the contract to minimize takes. Jacksonville has been a leader in advocating the use of *SI* to monitor hopper dredges for turtle safe operations. The district is also evaluating rental contracts and will use *SI* for QA of these contracts.